IN THE CLAIMS

What is claimed is:

1. A surgical instrument, comprising:

an end effector configured and adapted to engage tissue; and

at least one micro-electromechanical system (MEMS) device operatively connected to the surgical instrument for at least one of sensing a condition, measuring a parameter and controlling the condition and/or parameter adjacent the end effector.

2. The surgical instrument according to claim 1, wherein the at least one MEMS device is operatively connected to the end effector.

3. The surgical instrument according to claim 2, wherein the at least one MEMS device is selected from the group consisting of a pressure sensor, a strain sensor, a displacement sensor, an optical sensor, a biosensor, a temperature sensor, a torque sensor, an accelerometer, a flow sensor, an electrical sensor and a magnetic sensor for at least one of sensing, measuring and controlling the associated condition and/or parameter.

4. The surgical instrument according to claim 3, wherein the surgical instrument is a surgical stapler and the end effector includes:

a staple cartridge assembly; and

an anvil operatively associated with the staple cartridge, the staple cartridge and the anvil being movably connected to one another to bring one into juxtaposition relative to the other.

5. The surgical instrument according to claim 4, wherein each of the staple cartridge and the anvil define tissue contacting surfaces and the at least one MEMS device is operatively connected to at least one of the tissue contacting surface of the staple cartridge and the tissue contacting surface of the anvil.

6. The surgical instrument according to claim 5, wherein there is a plurality of MEMS devices connected to the surgical instrument, the MEMS devices being configured and adapted to measure distance between the tissue contacting surface of the staple cartridge assembly and the tissue contacting surface of the anvil.

7. The surgical instrument according to claim 6, wherein the MEMS devices are configured and adapted to measure the amount of pressure applied to tissue clamped between the tissue contacting surface of the staple cartridge and the tissue contacting surface of the anvil.

8. The surgical instrument according to claim 4, wherein the MEMS devices are configured and adapted to measure the thickness of the tissue clamped between the tissue contacting surface of the staple cartridge and the tissue contacting surface of the anvil.

9. The surgical instrument according to claim 4, wherein the end effector is configured and adapted to perform an anastomosis.

10. The surgical instrument according to claim 9, wherein the surgical instrument is a linear stapler that is adapted to perform an endoscopic gastrointestinal anastomosis.

11. The surgical instrument according to claim 9, wherein the surgical instrument is an annular stapler that is adapted to perform an end-to-end anastomosis.

12. The surgical instrument according to claim 3, wherein the end effector is a jaw mechanism including a pair of jaw members pivotably coupled to the distal end of the elongate shaft.

13. The surgical instrument according to claim 12, wherein at least one MEMS device is provided on at least one of the pair of jaw members.

14. The surgical instrument according to claim 13, wherein MEMS devices are provided at least at one of a proximal end, a distal end and along a length of each of the pair of jaw members.

15. The surgical instrument according to claim 14, wherein the jaw mechanism is configured and adapted to perform an electrosurgical function.

16. The surgical instrument according to claim 15, wherein the jaw mechanism is configured and adapted to deliver electrosurgical energy to a target surgical site.

17. The surgical instrument according to claim 3, wherein the surgical instrument is operatively couplable to a robotic system, wherein the end effector is configured and adapted to be remotely operated by the robotic system.

18. The surgical instrument according to claim 1, wherein there is included a loading unit having a proximal end and a distal end, the proximal end being selectively removably connected to the surgical instrument, the end effector is operatively connected to and part of the loading unit, and the loading unit includes the at least one MEMS device.

19. The surgical instrument according to claim 18, wherein the end effector is a surgical stapler including:

a staple cartridge assembly; and

an anvil operatively associated with the staple cartridge assembly, the staple cartridge assembly and the anvil being movable and juxtaposable relative to one another.

20. The surgical instrument according to claim 19, wherein each of the staple cartridge assembly and the anvil define tissue contacting surfaces and wherein at least one MEMS device is operatively connected to the at least one of the tissue contacting surface of the staple cartridge assembly and the tissue contacting surface of the anvil.

21. The surgical instrument according to claim 20, wherein the MEMS devices are configured and adapted to measure distance between the tissue contacting surface of the staple cartridge assembly and the tissue contacting surface of the anvil.

22. The surgical instrument according to claim 20, wherein the MEMS devices are configured and adapted to measure at least one of the amount of pressure applied to tissue and the thickness of tissue clamped between the tissue contacting surface of the staple cartridge assembly and the tissue contacting surface of the anvil.

23. The surgical instrument according to claim 18, wherein the loading unit has an elongate shaft having a distal end, the end effector being operatively connected to a distal end of an elongate shaft and the staple cartridge and the anvil are oriented transversely with respect to the elongate shaft.

24. The surgical instrument according to claim 18, wherein the end effector is configured and adapted to perform an anastomosis.

25. The surgical instrument according to claim 18, wherein the end effector is a jaw mechanism including a pair of jaw members pivotably coupled to the distal end of the elongate shaft.

26. The surgical instrument according to claim 25, wherein the at least one MEMS device is provided on at least one of the pair of jaw members.

27. The surgical instrument according to claim 28, wherein MEMS devices are provided at least at one of a proximal end, a distal end and along a length of each of the pair of jaw members.

28. The surgical instrument according to claim 27, wherein the jaw mechanism is configured and adapted to perform an electrosurgical function.

29. The surgical instrument according to claim 28, wherein the jaw mechanism is configured and adapted to deliver electrosurgical energy to the target surgical site.

30. The surgical instrument according to claim 3, wherein each of the plurality of MEMS devices is electrically connected to a control box via a lead wire extending from the housing.

31. The surgical instrument according to claim 3, further comprising:

a control box electrically connected to each of the plurality of MEMS devices via at least one wire lead.

32. A robotic system for performing surgical tasks, comprising:

a frame;

a robotic arm connected to the frame and movable relative to the frame;

an actuation assembly operatively associated with the robotic arm for controlling operation and movement of the robotic arm;

a loading unit including an elongate shaft operatively connected to the robotic arm, and an end effector operatively coupled to a distal end of the elongate shaft and configured to engage tissue; and

at least one micro-electromechanical system (MEMS) device operatively connected to the loading unit for at least one of sensing a condition, measuring a parameter and controlling the condition and/or parameter adjacent the end effector.

33. The robotic system of claim 32, wherein the at least one MEMS device is selected from the group consisting of a pressure sensor, a strain sensor, a displacement sensor, an optical sensor, a biosensor, a temperature sensor, a torque sensor, an accelerometer, a flow sensor, an electrical sensor and a magnetic sensor, for at least one of sensing, measuring and controlling an associated condition and/or parameter.

34. The robotic system of claim 32, wherein the end effector includes a pair of jaw members movably coupled to the distal end of the elongate shaft.

35. The robotic system of claim 34, wherein a plurality of MEMS devices are provided on each of the pair of jaw members.

36. The robotic system of claim 34, wherein a plurality of MEMS devices are provided at least at one of a proximal end, a distal end and along a length of each of the pair of jaw members.

37. The robotic system of claim 32, wherein the DLU is connected to the robotic arm via a bayonet-type connection.

38. The robotic system of claim 32, wherein the end effector is configured and adapted to perform an electrosurgical function.

39. The robotic system of claim 32, wherein the end effector is configured and adapted to deliver electrosurgical energy to the target surgical site.

40. The robotic system of claim 32, further comprising a controller including a processor and a receiver for receiving electrical signals transmitted from the actuation assembly and for controlling the operation and movement of the loading unit.

41. The robotic system of claim 32, wherein the end effector is selected from a group consisting of a fastener applier, a surgical stapler, a vessel clip applier and a vascular suturing assembly.

42. The robotic system of claim 32, wherein the end effector is a surgical stapler including a staple cartridge assembly and an anvil operatively associated with the staple cartridge assembly and in juxtaposition relative to the staple cartridge assembly, and wherein at least one MEMS device is operatively connected to each of the staple cartridge assembly and the anvil.

43. The robotic system of claim 42, wherein the staple cartridge assembly defines a tissue contacting surface and wherein at least one MEMS device is operatively connected to the tissue contacting surface of the staple cartridge assembly.

44. The robotic system of claim 43, wherein the anvil defines a tissue contacting surface and wherein at least one MEMS device is operatively connected to the tissue contacting surface of the staple cartridge.

45. The robotic system of claim 44, wherein the MEMS devices are configured and adapted to measure distance between the tissue contacting surface of the staple cartridge assembly and the tissue contacting surface of the anvil.

46. The robotic system of claim 44, wherein the MEMS devices are configured and adapted to measure the amount of pressure applied to tissue clamped between the tissue contacting surface of the staple cartridge assembly and the tissue contacting surface of the anvil.

47. The robotic system of claim 44, wherein the staple cartridge assembly and the anvil are transversely oriented with respect to the elongate shaft.

48. The robotic system of claim 44, wherein the staple cartridge assembly and the anvil are pivotably connected to the distal end of the elongate shaft.

49. The robotic system of claim 32, wherein the end effector is a vessel clip applier, the vessel clip applier comprising:

a body portion having a distal end and a proximal end, wherein the proximal end is operatively connectable to the robotic arm; and

a jaw assembly operatively connected to the distal end of the body portion, wherein the jaw assembly includes a first and a second jaw portion.

50. The robotic system of claim 49, wherein each of the first and the second jaw portions includes at least one MEMS device operatively connected thereto.

51. The robotic system of claim 32, wherein the end effector is a vascular suturing assembly, the vascular suturing assembly comprising:

an elongate body having a distal end and a proximal end, wherein the proximal end in operatively connectable to the robotic arm; and

a pair of needle receiving jaws pivotably mounted to the distal end of the elongate body portion, the pair of needle receiving jaws being configured and adapted to pass a surgical needle and associated length of suture material therebetween.

52. The robotic system of claim 51, further including at least one MEMS component operatively connected to each of the pair of needle receiving jaws.

53. A loading unit for use with a surgical instrument, comprising:

an elongate tubular shaft having a proximal end and a distal end;

an end effector operably connected to the distal end of the tubular shaft;

a connector for connecting the proximal end of the tubular shaft to a surgical instrument; and

at least one micro-electromechanical system (MEMS) device operatively connected to the loading unit for at least one of sensing a condition, measuring a parameter and controlling the condition and/or parameter adjacent the end effector.

54. The loading unit according to claim 53, wherein the at least one MEMS device is operatively connected to the end effector.

55. The loading unit according to claim 54, wherein the at least one of the MEMS device is selected from the group consisting of a pressure sensor, a strain sensor, a displacement sensor, an optical sensor, a biosensor, a temperature sensor, a torque sensor, an accelerometer, a flow sensor, an electrical sensor and a magnetic sensor for at least one of sensing, measuring and controlling an associated condition and/or parameter.

56. The loading unit according to claim 55, wherein the surgical instrument is a surgical stapler and the end effector includes:

a staple cartridge assembly; and

an anvil operatively associated with the staple cartridge, the staple cartridge and the anvil being movably connected to one another to bring one into juxtaposition relative to the other.

57. The loading unit according to claim 54, wherein each of the staple cartridge and the anvil define tissue contacting surfaces and the at least one MEMS device is operatively connected to at least one of the tissue contacting surface of the staple cartridge and the tissue contacting surface of the anvil.

58. The loading unit according to claim 57, wherein there is a plurality of MEMS devices connected to the surgical instrument, the MEMS devices being configured and adapted to measure distance between the tissue contacting surface of the staple cartridge assembly and the tissue contacting surface of the anvil.

59. The loading unit according to claim 58, wherein the MEMS devices are configured and adapted to measure the amount of pressure applied to tissue clamped between the tissue contacting surface of the staple cartridge and the tissue contacting surface of the anvil.

60. The loading unit according to claim 57, wherein the MEMS devices are configured and adapted to measure the thickness of the tissue clamped between the tissue contacting surface of the staple cartridge and the tissue contacting surface of the anvil.

61. The loading unit according to claim 56, wherein the end effector is configured and adapted to perform an anastomosis.

62. The loading unit according to claim 61, wherein the surgical instrument is a linear stapler that is adapted to perform an endoscopic gastrointestinal anastomosis.

63. The loading unit according to claim 62, wherein the surgical instrument is an annular stapler that is adapted to perform an end-to-end anastomosis.

64. The loading unit according to claim 55, wherein the end effector is a jaw mechanism including a pair of jaw members pivotably coupled to the distal end of the elongate shaft.

65. The loading unit according to claim 64, wherein at least one MEMS device is provided on at least one of the pair of jaw members.

66. The loading unit according to claim 75, wherein MEMS devices are provided at least at one of a proximal end, a distal end and along a length of each of the pair of jaw members.

67. The loading unit according to claim 53, wherein at least one MEMS device is a temperature sensing MEMS device.

68. The loading unit according to claim 67, wherein the temperature sensing MEMS device is positioned on and/or encapsulated in thermally conductive tips or elements, wherein the conductive tips are semi-rigid wires made of shape memory metal for a particular application, wherein the conductive tips are extendable out from the loading unit and into the tissue adjoining the loading unit in order to monitor temperature of the tissue adjoining the loading unit.

69. A surgical instrument for use with a loading unit that is operatively couplable to the surgical instrument and has an end effector with a pair of juxtaposable jaws for performing a surgical function, the end effector having at least one micro-electromechanical system (MEMS) device operatively connected thereto for at least one of sensing a condition, measuring a parameter and controlling the condition and/or parameter adjacent the end effector, the surgical instrument comprising:

a housing;

an elongate shaft that extends from the housing and has a distal end operatively couplable to a loading unit of the above type;

an approximation mechanism for approximating the pair of jaws;

an actuation mechanism for activating the jaws to perform the surgical function; and

at least one micro-electromechanical system (MEMS) device operatively connected to the surgical instrument for at least one of sensing a condition, measuring a parameter and controlling the condition and/or parameter adjacent the end effector and for cooperative operation with the at least one MEMS of the end effector.